RECOMMENDATIONS ON THE PREVENTION AND SUPPRESSION OF DUST IN MINING, TUNNELING, AND QUARRYING. ADOPTED AT A MEETING HELD UNDER THE AUSPICES OF THE INTERNATIONAL LABOR OFFICE, GENEVA, SWITZERLAND, DECEMBER 1-17, 1952

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary
BUREAU OF MINES
J. J. Forbes, Director

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FOREWORD

The exposure of workers in the mining and mineral industries to the potentially harmful effects of air-borne dust is a matter of concern in all countries where these industries are in progress. In recognition of the various problems involved in combatting this hazard, matters pertaining to the prevention and suppression of dust in mining, tunneling, and quarrying were discussed at a meeting of technical experts held under the auspices of the International Labor Office in Geneva, Switzerland, December 1-17, 1952. Those participating in the meeting represented government agencies, management and labor, and research, educational, and insurance organizations, all of whom were concerned with measures applicable to the protection of workers from harmful occupational exposure to air-borne dusts. Persons from the following countries participated in the meeting: Australia, Austria, Belgium, Canada, Chile, France, Germany, India, Italy, the Netherlands, Norway, Peru, Sweden, Switzerland, Union of South Africa, United Kingdom, and United States. Eighty-eight technical papers were prepared for discussion at the meeting and are listed in this circular.

As a result of these discussions, certain recommendations pertaining to practices for preventing and suppressing dust in mining, tunneling, and quarrying were adopted during the meeting. Because these recommendations represent the considered opinions of persons who have engaged in studies of practical measures for the control of dust in the mining and mineral industries throughout the world, the Bureau of Mines has issued this circular presenting these recommendations for the information of those concerned with this important subject.

AGENDA OF THE MEETING[1/]

The subjects discussed at the meeting are listed below:

I. Prevention of Dust Formation.

(1) Methods of working.

(2) Roof control and support.

(3) Drilling.

(4) Shotfiring (blasting).

(5) Substitutes for explosives.

(6) Coal cutting and getting machines.

(7) Transport.

1/ Reproduced from: Meeting of Experts on the Prevention and Suppression of Dust in Mining, Tunneling, and Quarrying, issued as supplement to Occupational Safety and Health, vol. 3, No. 2, April-June 1953, by the International Labor Office, Geneva, Switzerland.

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II. Suppression of Dust at Source of Formation.

(1) Drilling.

(2) Water infusion.

(3) Coal cutting and getting machines.

(4) Loading of mineral and dead rock.

(5) Pneumatic picks.

(6) Shotfiring.

(7) Transport.

(8) Preparation of coal, ores, and other minerals.

III. Prevention of Deposited Dust from Becoming Airborne.

(1) Watering.

(2) Spraying.

(3) Water screens.

(4) Wetting agents.

(5) Consolidation of dust deposits.

(6) Elimination of man-travelling on dusty roads.

(7) Elimination or reduction of shotfiring.

IV. Removal of Airborne Dust.

(1) Dust extraction and filtration.

(2) Mist projectors.

(3) Electrostatic precipitation.

(4) Dust deflection sheets.

(5) Ventilation.

V. Airborne Dust Sampling, Measurement and Analysis.

(1) Dust-sampling appliances.

(2) Sampling procedure.

(3) Dust counting, measurement, and analysis.

(4) Records.

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VI. Personal Protective Equipment.

(1) Design and use of respirators.

(2) Other devices.

VII. Supervision and Maintenance of Dust Prevention and Suppression Devices.

VIII. Education and Training of Workmen.

IX. Special Problems.

Special problems due to -

(a) stonedusting in coal mines;

(b) altitude;

(c) temperature;

(d) humidity.

X. International Cooperation.

RECOMMENDATIONS ON THE PREVENTION AND SUPPRESSION OF DUST IN MINING, TUNNELING, AND QUARRYING2/

Scope

1. The following recommendations should apply to all mines, tunnels and underground quarries, but to opencast quarries only in so far as persons can be exposed to dust injurious to health.

General

2. In the present state of knowledge, all dusts liberated in mining, tunneling and quarrying operations should be considered potentially injurious to health if breathed in sufficient quantity; dusts containing free silica should be considered specially injurious to health, the injurious particles being below 5 microns in diameter.

3. In all mining, tunneling and quarrying operations, the liberation of dust that is injurious to health, as well as the accumulation and propagation of such dust when airborne, should as far as possible be prevented.

4. In mining, tunneling and quarrying where there is dust injurious to health, suitable measures should be taken to protect persons against such dust and for the prevention of pneumoconioses.

5. All mines and quarries, as well as tunnels under construction, in which water is used for the prevention and suppression of dust, should be equipped with an adequate water distribution system.

6. Water used for dust suppression purposes should not present any health risk.

7. Dust should be suppressed as close as possible to its source of formation.

2/ See footnote 1.

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8. Effective dust prevention and suppression devices should be incorporated, preferably at the time of manufacture, in the machines and other equipment concerned.

9. When a particular measure designed to reduce dust production is taken, account should be taken of its possible adverse influence on dust production in the totality of operations.

I. Prevention of Dust Formation

1. Methods of Working

10. In planning any new mining or quarrying operation, and also any tunneling operation, due consideration should be given at the outset to means of preventing and suppressing dust, and especially to the influence of the general ventilation system.

11. The layout of the workings, ventilation, blasting and mechanical appliances used to get and transport the mineral or rock should be such as to reduce the production of dust to the minimum and to suppress the dust produced.

12. The free fall of material, both at the face and during transport, should be reduced to the minimum practicable.

2. Roof Control and Support

13. In selecting methods of controlling and supporting the roof, including methods of stowing or packing, due consideration should be given to means of preventing and suppressing dust.

14. As a general rule, the roof everywhere should be so controlled and supported as to reduce dust production to a minimum.

15. If pneumatic or mechanical methods of stowing are used, the stowing material should be suitably wetted to prevent dust from being carried into the air current.

16. Interruptions in pneumatic stowing, which cause dust to be blown into the atmosphere, should be reduced to the minimum practicable.

17. If any stone-crushing equipment is used underground, measures should be taken to prevent any dust resulting therefrom from penetrating into areas occupied by workers.

3. Drilling

18. All drilling in rock should be done in such a manner as to minimise the production of drilling dust that is injurious to health.

19. Whatever system of drilling is employed, all drillings should as far as practicable be evacuated from the borehole as they are produced during the drilling process, to prevent them from being crushed there.

20. Where practicable, drills should be so mounted as to reduce the effort required of the miner and hence his rate of respiration.

21. Whether drilling in rock is done by rotary or percussive drills, the production of dust should be reduced by -

(a) using bits in good condition;
(b) keeping suitable pressure on the bit; and
(c) clearing the cuttings from the bit.

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22. The exhaust from pneumatic drills should be so arranged as not to raise dust.

4. Shotfiring (Blasting)

23. The times for shotfiring should be chosen so that the minimum number of persons are exposed to the dust produced.

24. The shotfiring pattern, as well as the nature and quantity of explosives used, should be adapted to the rock or mineral to be brought down, with a view to reducing the production of dust to a minimum.

25. The number of shotfiring operations should be reduced as far as practicable by all appropriate means, in particular the firing of multiple shots.

26. During shotfiring, the personnel likely to be affected by it should, in so far as the necessity for guarding approaches permits, not be allowed to stay in places where the air will be unduly polluted by shotfiring.

27. Persons responsible for shotfiring should have been suitably instructed in the dust risks involved.

5. Coal Cutting and Getting Machines

28. The design, material, arrangement and conditions of picks on coal-cutting machines should be such as to reduce the production of fine dust to the minimum.

29. The chain speed should not be excessive in relation to the speed of advance of the machine; the chain should always be equipped with a complete set of picks and should not be left running unnecessarily.

30. Holings should not recirculate and become crushed.

31. The exhaust of compressed-air driven machines should be so arranged as not to raise dust.

6. Transport

General

32. Unless other effective measures are taken during loading and transport, wetting should be repeated as often as is necessary to counteract evaporation and disintegration.

33. Loading, transfer and discharge points should be so arranged and used as to reduce disintegration of the material to a minimum.

34. The number of transfer points should be as small as practicable.

35. Transport equipment should be built, installed and used so as to avoid spillage as far as practicable.

36. Transport roads should be properly maintained and cleared of dust as frequently as necessary, or consolidated.

37. Material transported should not be exposed to high-velocity air currents.

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38. The exhaust of compressed-air and internal combustion engines should be so arranged as not to raise dust.

39. Workers employed at loading and transfer points should, as far as practicable and necessary, be stationed in the incoming air current.

Tubs (Cars)

40. Unless the material is already wet, or other effective measures of preventing dust from being dispersed from the tub in transit are taken, it should be watered as soon as tubs (cars) are loaded.

Conveyors

41. Conveyors of all types should be so designed, installed and used that the production and spillage of dust is reduced to the minimum practicable.

42. Fine dust adhering to the belts of belt conveyors should be removed continuously and collected.

43. The movement of conveyors should, as far as practicable, be so regulated that no material will accumulate at transfer points.

Chutes, Spiral Conveyors, etc.

44. The descent of material in chutes, spiral conveyors, ore passes, tipples and skip loading and unloading installations should be controlled so as to reduce the production of dust to the minimum practicable.

45. Spiral conveyors should be of dust-tight construction and, unless liberation of dust is prevented by other methods, they should be kept as full as practicable.

II. Suppression of Dust at Source of Formation

1. Drilling

46. Either wet or dry methods of suppressing dust that is injurious to health should be applied in drilling rock.

47. The dust suppression device should, as far as practicable, be used throughout the drilling operation, including the collaring.

48. Drills with a water feed should be so constructed that the drill and the water feed are operated simultaneously.

49. In wet drilling, the water should penetrate to the bottom of the hole in sufficient quantity and under sufficient pressure, and drill steels should be so designed as to permit this.

50. Pneumatic drills with an axial water feed should be so constructed that the water does not carry air through the drill steel.

2. Water Infusion

51. Wherever necessary and practicable, coal faces should be infused with water at a suitable interval before coal getting begins.

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52. Details of the method by which each face is to be infused should be determined by experience covering matters such as the quantity and pressure of the water, and the siting, direction and depth of boreholes.

53. The flow and pressure of the water should be checked during infusion.

54. The personnel responsible for water infusion should be given suitable instructions for this purpose.

3. Coal-Cutting and Getting Machines

55. Where necessary, effective measures should be taken to suppress dust during coal cutting.

56. All coal-cutting and getting machines should be supplied by the manufacturers equipped with devices for suppressing dust.

57. The dust-suppression equipment should be protected against mechanical damage.

4. Loading of Mineral and Dead Rock

58. In underground workings and, if necessary, on the surface, unless other effective means of dust suppression are used, all mineral and dead or waste rock should be thoroughly watered throughout loading.

59. When material is loaded from chutes, effective means should be provided for suppressing dust.

5. Pneumatic Picks

60. Pneumatic picks should be supplied by the manufacturers equipped with suitable fittings for applying sprays and for deflecting or diffusing the exhaust, and with sealed pick holders.

61. The quantity of water sprayed should be reduced to the minimum necessary to suppress the dust effectively.

62. Wet pneumatic picks should be constructed so that the pick and the water feed are operated simultaneously.

63. The water supplied to pneumatic picks should be filtered.

6. Shotfiring (Blasting)

64. The dust from shotfiring should be actively removed by ventilation and, where necessary, be allayed with sprays or fog guns, or passed through filters.

65. The sprays or fog guns (mist projectors) used to allay dust from shotfiring (blasting) should effectively cover the entire cross-section of the working or installation in which they are used.

7. Transport

66. Transfer and loading points should either be so designed as to prevent the dispersal of dust into the air, or the dust produced should be suppressed by suitable wet or dry methods.

67. Spillage occurring during transport should be constantly cleaned up.

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8. Preparation of Coal, Ores, and Other Minerals

68. Preparation plant liberating dust in dangerous quantities should be equipped with suitable dry or wet dust-suppression devices.

III. Prevention of Deposited Dust from Becoming Airborne

1. Watering and Spraying

69. Water used for consolidating dust should not be applied with such force as to raise dust into the air.

70. Watering or spraying should be repeated as often as is necessary to maintain its efficacy.

71. Before any shots are fired the floor, roof and sides in the vicinity should, where practicable and not objectionable for any reason, be thoroughly wetted if necessary.

72. The personnel concerned should be properly instructed in the technique of watering and spraying.

2. Wetting Agents

73. Wetting agents should not be used in any way that might be unsafe or injurious to health.

3. Consolidation of Dust Deposits

74. If other methods of preventing dust underground from becoming airborne are ineffective or impracticable, the dust in roads should be consolidated by suitable means, for example, sodium chloride or calcium chloride.

4. Traveling on Dusty Roads

75. The main body of men forming shifts, and other large groups, who have to travel to and from work over long distances on dusty roads underground should be transported.

IV. Removal of Airborne Dust

1. Dust Extraction and Filtration

76. Airborne dust should be arrested as speedily and completely as possible by dry or wet methods, or by a combination of the two.

77. When wet methods are used, the water should cause the dust to impinge on a surface on which it will be arrested.

78. When dry methods are used, the dust should be filtered or precipitated.

79. Wherever practicable, the extraction and filtration of airborne dust should be effected in ducting rather than in roadways.

80. Dust extraction and filtration devices should have a particularly high efficiency in the size range below 5 microns in diameter.

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81. The efficiency of dust extraction and filtering devices should be checked periodically.

82. Measures should be taken to prevent extracted dust from becoming airborne again; such dust should be removed either in dust-tight containers or in the form of mud after wetting.

83. Filters should be cleaned at intervals such that the resistance to the passage of air is not unduly increased.

2. Mist Projectors and Dust-Deflection Sheets

84. Wherever practicable, mist projected on fine dust should be directed against a surface such as a wall or a brattice sheet, so as to take advantage of the impingement effect of dust and water; suitable arrangements should be made to evacuate the sludge formed.

3. Ventilation

85. In all mines and in tunnels under construction, the ventilation system should be planned by a qualified person, so as to ensure that airborne dust is effectively diluted and removed.

86. The air supplied to the working places should be as clean as possible, and, as far as practicable, the air velocity should nowhere be high enough to raise dust.

87. In tunnels under construction, the system of ventilation should be so chosen, installed and used, and the ventilation should be so powerful, as to keep the air clear of dust where persons work.

V. Airborne-Dust Sampling, Measurement and Analysis

Dust-Sampling Appliances

88. Dust-sampling appliances used in mines, tunnels, and quarries should enable the concentrations of airborne dust particles and aggregates to be measured by counting the particles over an appropriate size range below 5 microns in diameter, or by weight, or by other reliable parameters.

89. Appliances used for routine dust measurements in mining, tunneling and quarrying should be simple and recognised as reliable for this purpose.

Sampling, Counting, Measurement, and Analysis

90. Airborne-dust sampling should be done in a manner that will provide adequate information on dust conditions.

91. Dust sampling, counting, measurement and analysis should be undertaken by personnel trained for these purposes.

Records

92. The record of each sample should include adequate particulars of the conditions in which it was taken, the dust concentrations and the sampling and evaluation methods employed.

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VI. Personal Protective Equipment

93. Persons should wear suitable respirators when working in injurious dust concentrations that cannot be suppressed; they should be properly trained in the use of such respirators.

94. Respirators should be of types tested and approved by a competent body.

95. Filter respirators should have a high extraction efficiency for particles below 5 microns in diameter and maintain a low resistance to breathing.

96. When supplied-air respirators or hose masks are used, the air supplied should not be injurious to health.

97. Respirators should be cleaned regularly and inspected at suitable intervals.

98. In mining, quarrying, and tunneling undertakings in which large number of respirators are used, qualified persons, properly trained, should be specially appointed to maintain respirators in good condition; this work should be carried out in a suitable room which is equipped with apparatus necessary for cleaning and testing the respirators as to fitness for use.

VII. Supervision and Maintenance of Dust-Prevention and Suppression Devices

99. All dust-prevention and suppression devices should be suitably supervised, to ensure that they are properly used and maintained in good condition.

100. Supervision should be entrusted to qualified persons appointed by the management for this purpose.

VIII. Education and Training of Personnel

101. Dust prevention and suppression should be the responsibility of management, and workmen should cooperate fully in this field.

102. The courses of instruction given in centers for apprentices and in the trade and technical schools concerned should include adequate treatment of the subject of dust, its dangers, prevention, and suppression.

103. Systematic efforts should be made by managements to familiarize the workers and supervisory staff concerned with the reasons why it is necessary to protect the health of all persons exposed to risk from dust, and to instruct them in the proper application of devices and measures for the prevention and suppression of dust.

IX. Special Problems

Stonedusting in Coal Mines

104. Dust used for stonedusting in mines should not be injurious to health.

Proposals for International Cooperation

(Summarized by Bureau of Mines)

Recommendations were adopted also relating to international cooperation through the exchange of publications and other pertinent information on matters regarding prevention and suppression of dust in mining, tunneling, and quarrying, with such cooperation and exchange to be centralized through the International Labor Office.

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PAPERS PREPARED FOR THE MEETING3/

Australia

A Brief Review of Dust Suppression Practices in New South Wales Coal Mines. By F. M. Jefferson, mining engineer; mine manager; Member of the Coal Dust Commission of the Commonwealth Scientific and Industrial Research Organisation; Sydney.

Mine Ventilation in Western Australia. By A. W. Ibbotson and J. M. Faichney, assistant inspectors of mines, Western Australian Department of Mines.

Austria

Qualitative and Quantitative Criteria for the Practical Assessment of Dust Risks on the Basis of Konimeter Measurements. By H. Zechner, director of the Austrian Dust (Silicosis) Institute, Leoben.

Prevention and Suppression of Dust in Mining. By F. Bartosch, mining engineer, director and chief of Division in the Central Mining Administration, vice-chairman of the Dust Prevention and Suppression Service, Vienna.

Belgium

Water Infusion in Coal Seams by Means of Explosives. By E. Demelenne, Principal Divisional Mining Engineers, Mons.

Influence of the Draining of Firedamp on the Dust Content of the Ventilation Current in Gassy Mines. By E. Demelenne.

Dust Suppression in Coal Mines. By A. Houberechts, director, Miners' Health Institute, Hasselt.

Dust Suppression in the Use of Pneumatic Picks. By A. Houberechts.

Dust Suppression by Water Infusion in the Solid. By A. Houberechts.

Dust Suppression by Water Spraying. By A. Houberechts.

Wetting Agents. By A. Houberechts.

Dust Sampling, Measurement and Analysis. By A. Houberechts.

Control of Mine Climate in Hot and Damp Mine Workings. By A. Houberechts.

Canada

Some Observations on Canadian Practice in the Suppression and Control of Silica and Related Mine Dusts. By J. Crawford, Director of Mines, Edmonton, Alberta.

France

The Present Position in France with Regard to the Prevention of Silicosis in Underground Construction and in Works Producing Silica Dust. By P. Expilly, consulting engineer, Organisation for Safety in Building and Civil Engineering, Paris.

3/ See footnote 1.

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Dust Measurement and Research in Underground Civil Engineering Works. By P. Expilly.

Education and Training of Personnel in the Prevention of Silicosis on Public Works Projects. By Dr. R. Nussbaum, Medical Officer, Contractors' Joint Centre, Luz-Saint-Sauveur (Hautes-Pyrenees).

Quantitative Determination of Crystallised Silica by Differential Thermal Analysis. By H. Sauzéat, Director of the Dust Laboratory, Loire, Basin Mines, St. Etienne.

Rational Ventilation in the Driving of Tunnels. By J. Fourestier, engineer, Assistant to the Chief of the Prevention and Safety Service of Electricité de France, Paris.

Dust Suppression Measures in the Segré Iron Mines (Maine-et-Loire).

Dust Suppression Measures in the Angers Slate Quarries. By M. Tesson, chief engineer, Commission des Ardoisiéres d'Angers.

The Prevention of Silicosis in the "Mines et Usines de Salsigne." By M. Lyonnais, Technical Director of the Mines et Usines de Salsigne, La Combe du Saut (Aude).

Water Infusion in the Solid in the Brassac Coal Mines. By M. Perroud, engineer, Auvergne Basin Coal Mines, Clermont-Ferrand.

Dust Suppression in the Coal Mines of the Cevennes Basin. By M. Hubert, chief engineer Cevennes Basin Coal Mines, Alés.

Dust Suppression in the Saar and Moselle Group of the Lorraine Basin Coal Mines. By J. Chappellon, divisional engineer, Saar and Moselle Group, Merlebach.

Some Aspects of Dust Control in the Coal Mines of the Saar Mining Administration. By M. Rittner, divisional engineer, chief of the Dust Control Station, Saarbrücken.

Dust Suppression in Machine Cutting by Wet Methods. By M. Bessiére, divisional engineer, chief of the Safety Department of the Saar Mining Administration, Saarbrücken.

The Suppression of Dust by Water Infusion in the Solid. By M. Bernos, chief mining engineer, Director of the Maybach Mine, Saar Mining Administration.

Germany

Testing and Assessment of Dust Masks in Germany. By D. Hasenclever, physicist, Dust Research Institute of the Federation of Industrial Mutual Accident Insurance Associations, Bonn.

The Determination of the Silicosis Risk of Rock-Drilling Dust and Airborne Dust on the Basis of Mineralogical Investigation. By M. Lanwehr, mining engineer, Technical Director of the Silicosis Research Institute of the Mutual Accident Insurance Association for the Mining Industry, Bochum.

Prevention of Dust Formation during Mineral Getting in Metal Mines. By R. Kortschik, mining engineer, Technician in the Silicosis Research Institute of the Mutual Accident Insurance Association for the Mining Industry, formerly Dust Specialist in the Zwickau District Mining Office, Bochum.

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Prevention of Dust Formation and Suppression of Dust at the Source of Formation in Transport. By R. Kortschik.

Suppression of Dust at the Source of Formation in Shotfiring. By R. Kortschik.

Sampling, Measurement and Analysis of Airborne Dust. By W. Walkenhorst, chief of the Physical Department of the Silicosis Research Institute of the Mutual Accident Insurance Association for the Mining Industry, Bochum.

Use of Wetting Agents. By H. Neu, director of the Chemical Laboratory of the Silicosis Research Institute of the Mutual Accident Insurance Association for the Mining Industry, Bochum.

Consolidation of Dust Deposits by Application of Salts. By H. Neu.

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Italy

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Norway

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Peru

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Sweden

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Dust Measurements and Measures against Dust at the Laisvall Mine in Sweden. By T. Sjöqvist, safety engineer, the Boliden Mining Co., Boliden.

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United States of America

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